Simpson

INSTRUMENTS THAT STAY ACCURATE

OPERATOR'S MANUAL

WARNING

For safe usage, it is essential that the operator read this manual carefully before the instrument is used for any measurements.

MODEL 294 AMP-CLAMP® AMMETER
MODEL 295 AMP-CLAMP® VOLT-AMMETER
MODEL 296 AMP-CLAMP® VOLT-OHM-AMMETER

AMP-CLAMP® is a Registered Trademark of the Simpson Electric Company

SIMPSON ELECTRIC COMPANY

853 Dundee Ave., Elgin, Illinois 60120
Area Code 312, Telephone 695-1121
In Canada, Bach-Simpson, Ltd., London, Ontario

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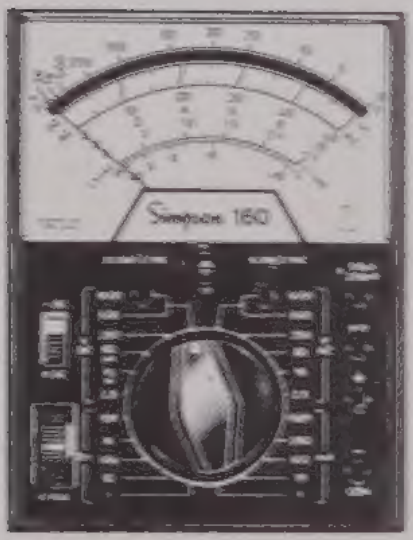

160 Handi-VOM

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with Full-Size VOM Features

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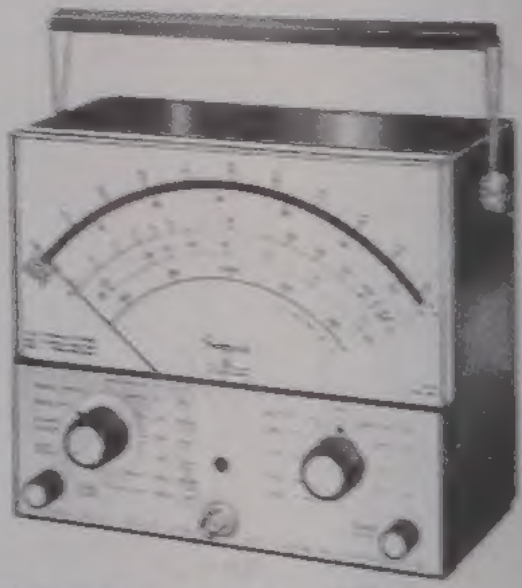
- ±2% DC . . . ±3% AC
- 5 Resistance Ranges . . . Plus a 0-250 DC Millivolt Range



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OPERATOR'S MANUAL

MODEL 294 AMP-CLAMP® AMMETER
MODEL 295 AMP-CLAMP® VOLT-AMMETER
MODEL 296 AMP-CLAMP® VOLT-OHM-AMMETER

SIMPSON ELECTRIC COMPANY

853 Dundee Ave., Elgin, Illinois 60120
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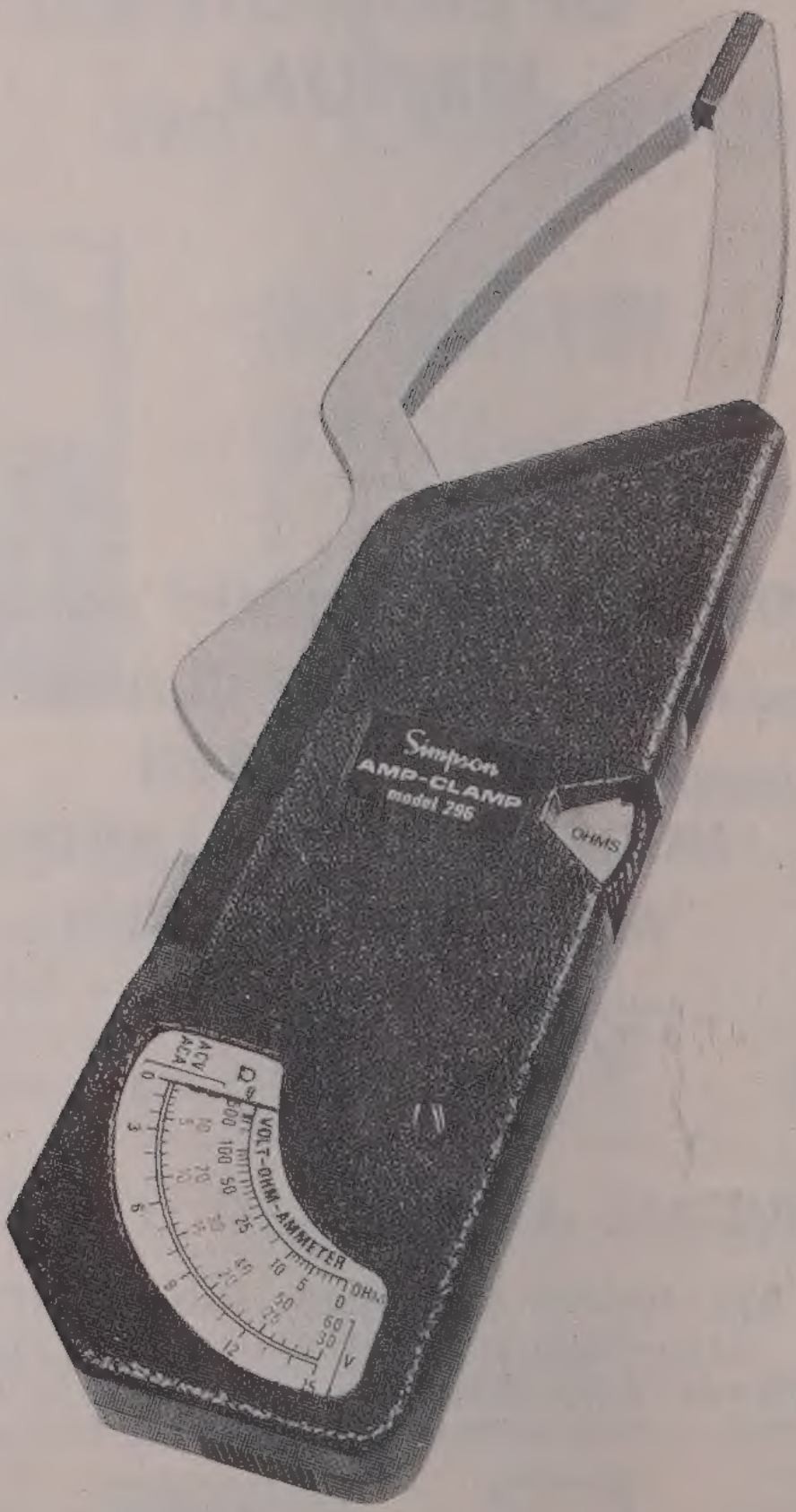

Figure 1-1. Simpson Amp-Clamp

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WARNING

The Models 294, 295, and 296 are designed to prevent accidental shock to the operator when properly used. However, no engineering design can render safe an instrument which is used carelessly. Therefore, this manual must be read carefully and completely prior to making any measurements. Failure to follow directions can result in a serious or fatal accident.

SHOCK HAZARD: As defined in American National Standard, C39.5, Safety Requirements for Electrical & Electronic Measuring & Controlling Instrumentation, a shock hazard shall be considered to exist at any part involving a potential in excess of 42.4 volts peak (DC, AC peak or DC plus AC peak), or where a leakage current from that part to ground exceeds 0.5 milliampere, when measured with an appropriate measuring instrument defined in Section 11.6.1 of ANSI C39.5.

(NOTE: The proper measuring instrument for measurement of leakage current consists essentially of a network of a 1500 ohm non-inductive resistor shunted by a 0.15 microfarad capacitor connected between the terminals of the measuring instrument. The leakage current is that portion of the current that flows through the resistor. The Simpson Model 229-Series 2 AC Leakage Current Tester

meets the ANSI C39.5 requirements for the measurement of AC leakage current and can be used for this purpose. To measure DC leakage current, connect a 1500 ohm non-inductive resistor in series with a Simpson 0-500 DC microammeter and use this as the measuring instrument.)

SECTION I
INTRODUCTION

1.1 GENERAL

1.1.1 The Simpson Amp-Clamp Models 294, 295 and 296 (hereafter referred to as Model 294, 295 and 296 Amp-Clamp, or simply the Instrument) are rugged Instruments designed for general purpose testing.

1.1.2 The Models 294, 295 and 296 are analog readout Instruments designed with a self-shielded core type movement and protected from overload by a varistor. These Instruments also feature a finger-operated lever which clamps the pointer at the reading being made, thus providing a capability to take measurements without looking at the indicator, and then later observing the indicated value. With the Amp-Clamp, current measurements are made without disconnecting or breaking into the line being checked. By clamping the Amp-Clamp

jaws around one of the current-carrying lines, quick and accurate measurement can be obtained. The jaws are shaped to allow easy insertion into crowded wire assemblies.

1.1.3 The Model 294 measures AC current with 3% accuracy. The Model 295 measures both AC current and AC voltage with 3% accuracy, the voltage measurements being made with test leads supplied with each instrument. The Model 296 measures AC current, AC voltage and resistance with 3% accuracy. A self-contained 1.5 volt AAA size alkaline battery supplies the power for resistance measurements. The resistance circuit is protected by a 1/4 ampere fuse, and a spare fuse is provided. Both battery and fuses are readily accessible under the cover plate on the bottom of the Instrument.

1.2 ACCESSORIES AND SUPPLIES

All items required for operation of the Instrument are furnished with the Instrument (refer to Table 7-1).

1.3 TECHNICAL DATA

Table 1-1 lists the technical specifications for the Simpson Amp-Clamp Instruments.

Table 1-1. Technical Data

1. **AC Current, Models 294, 295 and 296**

Ranges:	0-6, 15, 30, 150 and 300 RMS Amperes
Accuracy:	±3% of full-scale at 60 Hz sine wave with conductor centered.
Temperature Error:	Less than 1% of full scale between 15°C to 35°C

2. **AC Voltage, Models 295 & 296**

Ranges:	0-30, 150, 300 and 600 RMS Volts
Accuracy:	±3% of full-scale at 60 Hz Sine Wave
Temperature Error:	0.5% of full-scale max. between 15°C to 35°C

3. **Resistance, Model 296**

Range:	0-500 ohms (25 ohm center)
Accuracy:	±3% of Arc

4. **Rated Circuit-To-Ground Voltage***

600V RMS Max. (850V peak)

5. **Weight:** 14 oz. (.40 kg)

6. **Dimensions:** 10" long x 2.7" wide x 1.4" high (254 x 65.6 x 35.6 mm)

* NOTE, per American National Standard, C39.5 (April 1974), Safety Requirements for Electrical & Electronic Measuring & Controlling Instrumentation, RATED CIRCUIT-TO-GROUND VOLTAGE is defined to mean: "The specified voltage with respect to ground which may be safely and continuously applied to the circuits of an instrument."

SECTION II

INSTALLATION

2.1 UNPACKING AND INSPECTION

2.1.1 Examine the shipping carton for obvious signs of damage prior to unpacking. If shipping carton is in good condition, then unpack and inspect the Instrument for possible damage incurred during shipment. Also, check that all items are included (see Table 7-1). If damage is noted, notify the carrier and supplier and do not attempt further use of the Instrument. If Instrument appears to be in good condition, read Operator's Manual in its entirety. Become familiar with the Instrument as instructed in the manual, then proceed to check the electrical performance as soon as possible.

2.1.2 Save the shipping carton and packaging materials for future storing or shipping of the Instrument.

2.2 POWER REQUIREMENTS

2.2.1 The Models 294 and 295 Amp-Clamp's do not require the use of batteries or an external power source.

2.2.2 The Model 296 requires the use of a battery for powering the resistance measuring circuit. One 1.5 volt AAA alkaline (NEDA No. 24A) cell is used. Refer to paragraph 6.4 for battery installation.

2.3 INSTALLATION

These Instruments can be used in any position convenient to the operator.

SECTION III
CONTROLS, CONNECTORS AND INDICATORS

3.1 GENERAL

This section describes all operating controls, connectors and the indicator of the Amp-Clamp, Models 294, 295 and 296. Become familiar with each item of a particular model prior to operating the Instrument.

3.2 DESCRIPTION

Table 3-1 lists all controls, connectors and the indicator. See Figure 3-1 for identification.

Table 3-1. Controls, Connectors and Indicator

1. Range Selector Switch

Switch Position	
6A, 15A, 30A, 60A, 150A, 300A (Models 294, 295, & 296)	Selects the desired range setting for AC current. Measurements are made by clamping jaws around a single current carrying conductor.
30V, 150V, 300V, 600V (Models 295 & 296)	Selects desired range setting for AC volts. Voltage is measured with test leads (supplied).
OHMS (Model 296)	Selects circuit required for resistance measurements. The resistance is measured with test leads (supplied).

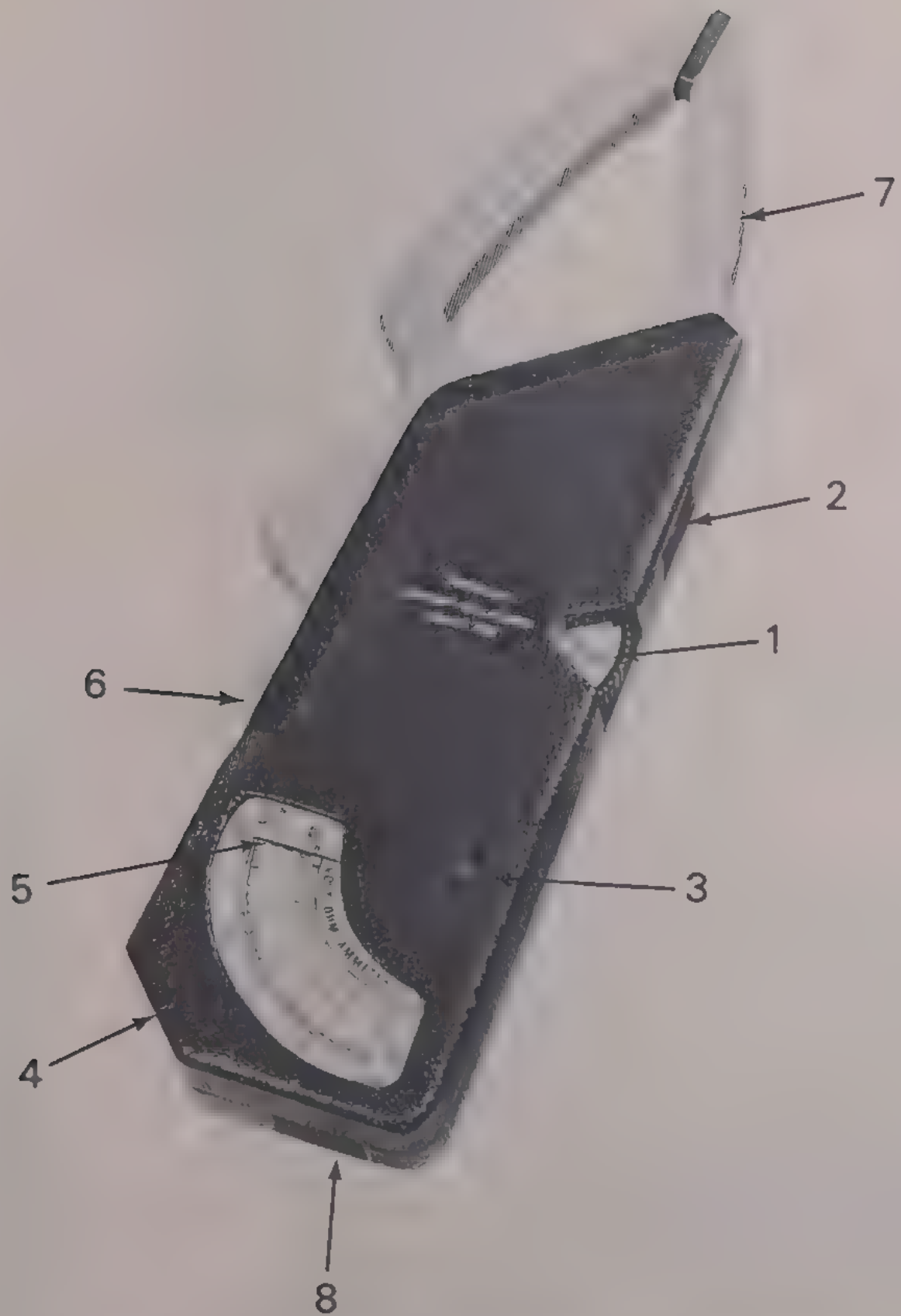

Figure 3-1. Controls, Connectors and Indicator

2. Ohms Adjust (Model 296)	This control zero adjusts the Instrument with test leads shorted together.
3. Pointer Zero Adjust	This control adjusts the pointer to coincide with the zero point on the dial with no input signal.
4. Terminals (Models 295 & 296)	The terminals are the input for the voltage and resistance measurements, and have no polarity or ground reference.
5. Pointer	The pointer indicates the value of the measured parameter (amperes, volts, resistance).
6. Pointer Lock Lever	When lifted toward the front of the Instrument, the lever locks the pointer to the dial. The pointer is released when the lever is set to the rear position.
7. Clamp Jaws	Used for making AC current measurements. The spring loaded jaws are clamped around a single current carrying conductor.
8. Battery & Fuse (Model 296) Compartment Cover	This cover provides access to the battery and fuse compartment. A spare fuse is also provided inside the compartment.

SECTION IV

OPERATION

4.1 GENERAL

4.1.1 This section of the manual contains all the information required to use and operate the Amp-Clamp in a safe and proper manner. Special notes and instructions have also been provided for added user safety and convenience.

4.2 SAFETY PRECAUTIONS

4.2.1 The Amp-Clamp is designed to be used only by personnel qualified to recognize shock hazards and trained in the safety precautions required to avoid possible injury. Refer to SHOCK HAZARD definition on page v.

4.2.2 Do not work alone when making measurements where a shock hazard can exist. Notify a nearby person that you are, or intend to make such measurements.

4.2.3 Voltages might appear unexpectedly in defective equipment. Whenever possible, remove all power from the circuit when making connections or disconnections.

4.2.4 Locate all voltage and current accessibility paths prior to making any measurement or connections of equipment under test.

4.2.5 For your own safety, inspect the Instrument and test leads for cracks, breaks or crazes in the insulation and replace the defective item(s) immediately.

4.2.6 Do not make measurements in a circuit where corona is present. Corona can be identified by a pale-blue color emanating from sharp metal points in the circuit, or by a buzzing sound, or by the odor of ozone. In rare instances, such as around germicidal lamps, ozone might be generated as a normal function. Ordinarily the presence of ozone indicates presence of high voltage, and possibly an electrical malfunction of some kind.

4.2.7 Hands, shoes, floor and workbench must be dry. Avoid making measurements under humid, damp or other environmental conditions that could effect the dielectric withstanding voltage of the test leads of the Instrument.

4.2.8 Do not use test leads which differ from those originally furnished with the Instrument. When using the insulated alligator clip leads for voltage measurement (Models 295 and 296) be sure the insulator boot covers all exposed metal at the connection.

4.2.9 Do not connect this Instrument to any circuit in which the voltage, with respect to ground, exceeds the rated circuit-to-ground voltage specified in Table I (Item 4).

4.3 AC CURRENT MEASUREMENTS, Models 294, 295 and 296

a. **READ AND HEED THE WARNING IN PARAGRAPH 4.1.**

b. Disconnect the test leads from the Instrument.

c. Set the range selector switch to the appropriate ampere range. If the magnitude of the current being measured is unknown, start with the 300 ampere range.

d. Clamp the jaws of the Amp-Clamp around one (only) of the current carrying wires to be measured. Make certain the jaws are completely closed.

NOTE: There will be no meter indication if the Amp-Clamp jaws are clamped around both conductors, as in a power cord, because the opposing magnetic fields will cancel each other.

e. Reset the range selector switch, if necessary, to obtain pointer indication in the upper portion of the scale for maximum reading accuracy.

f. Read the current value from the appropriate scale as indicated by the selector switch position.

g. If the Amp-Clamp is in a position where the pointer position cannot be accurately seen, the pointer lock actuator can be flipped up with a finger. This will clamp the pointer to permit reading the indicated value after removing it from the wire.

4.4 AC VOLTAGE MEASUREMENTS, Models 295 and 296

a. **READ AND HEED THE WARNING IN PARAGRAPH 4.1.**

b. Connect the test leads to the Amp-Clamp input terminals and twist the connectors 1/8 turn to lock them in place.

c. Set the range selector switch to the appropriate voltage range. If not known, start with the 600 volt range.

d. If possible, remove all power and discharge any capacitors in the circuit to be measured. Test leads may be used to make connections. Make certain that the lead insulating boots cover the metal leads.

e. If power cannot be removed, remove the clip from the red probe, connect the black test lead to the ground side of the circuit and use the red probe to contact the live side of the circuit. Keep hands away from live parts.

f. Connect test leads to the circuit and apply power.

g. Reset the range selector switch, if necessary, to obtain a pointer indication in the upper portion of the scale for maximum reading accuracy.

h. Read the voltage value from the appropriate scale as indicated by the selector switch position.

i. Remove power and discharge any capacitors before disconnecting test lead connections.

4.5 RESISTANCE MEASUREMENTS, Model 296

a. **MAKE CERTAIN ALL POWER IS REMOVED AND ALL CAPACITORS IN THE CIRCUIT ARE DISCHARGED BEFORE IN-CIRCUIT RESISTANCE MEASUREMENTS ARE TO BE MADE.**

b. Connect the test leads to the Amp-Clamp input terminals and twist the connectors 1/8 turn to lock them in place.

c. Set selector switch to OHMS position.

d. Short the leads and adjust ohms adjust knob for zero ohms indication. (If there is no pointer deflection, check fuse. If pointer deflects but cannot be adjusted to zero ohms, replace battery.)

e. Connect test leads across resistance being measured. Read resistance on OHMS scale of meter.

4.6 APPLICATION INFORMATION

4.6.1 Current Measurements, Models 294, 295 & 296

a. The Amp-Clamp is a practical and valuable electrical testing tool. It is largely used for tracing faults, diagnosing operating troubles and checking and/or balancing distribution circuits without initially turning the power off to install an ammeter. It can be used to measure the running current of electric motors without the problem of by-passing the heavy starting current.

b. Because current can only be measured thru a single conductor, a useful accessory, Simpson Model 151 Line Splitter (Catalog No. 00534),

can be used with the Amp-Clamp in checking equipment where the conductors are encased in a single cord, or cannot be isolated.

4.6.2 Sensitivity Increase

a. The Model 151 Line Splitter also provides a convenient means of increasing the sensitivity of the Amp-Clamp by a factor of 10.

b. As stated in Section V, the Amp-Clamp functions as a split-core transformer. Other multiples of increased sensitivity can be obtained by winding turns around one of the jaws of the Amp-Clamp, as shown in Figure 4-1.

c. If ten turns are wound on the jaw, and the range selector is set on the 6 amp range, then a current of 600 milliamperes in the current carrying AC line will read full scale on the Indicator. Divide the reading on the scale by 10 to obtain the actual current.

4.6.3 Voltage Measurements, Models 295 & 296

The voltage ranges on the Amp-Clamp were selected so that the line voltages of 120, 240, and 480 volts could be accurately determined. The 30 volt range is useful in checking thermostat circuits in heating and air-conditioning applications.

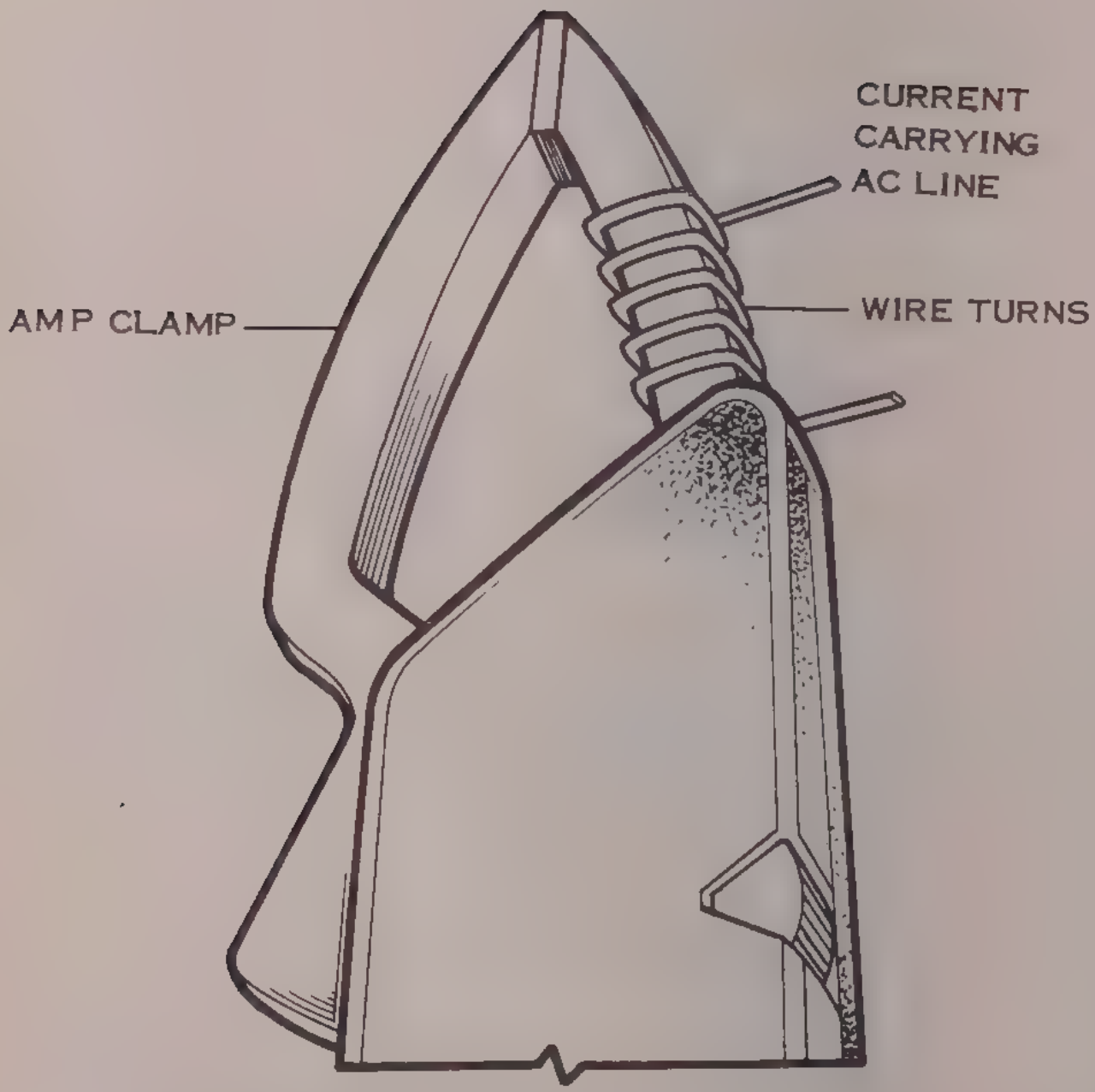

Figure 4-1. Increasing Sensitivity of Amp-Clamp

4.6.4 Resistance Measurements, Model 296

a. The resistance range can be used to accurately measure low values of resistance between zero and 500 ohms. This ohmmeter feature is also useful as a continuity tester for checking motor windings, fuses, switches, etc.

b. The resistance range can be used to check a capacitor for a serious fault. When connected, the capacitor's charging current will cause a momentary deflection toward zero ohms and a slow return to infinity as the capacitor charges. The amount of deflection and time to return to infinity are proportional to the capacitance. Small capacitances will produce a deflection so small as to be difficult to observe. A faulty capacitor will, however, indicate a fixed resistance value (shorted) or will not produce a momentary deflection of the meter (open). Once charged, the capacitor cannot be rechecked until first discharged.

c. The resistance range may be used to check semiconductors for open or shorted junctions.

SECTION V

THEORY OF OPERATION

5.1 AC CURRENT MEASUREMENTS

The Amp-Clamp, in effect, functions as a split core transformer to measure current in a conductor under test. The current-carrying conductor acts as a transformer primary, and a coil on the clamp core serves as the secondary. The magnetic field that surrounds the current carrying conductor induces a voltage, which is proportional to the current, into the secondary coil. This voltage is rectified and applied to the indicating circuit.

5.2 AC VOLTAGE MEASUREMENTS

Measured voltages are reduced in value by series dropping resistors, then rectified and applied to the indicating circuit.

5.3 RESISTANCE MEASUREMENTS

5.3.1 The unknown resistance is placed in series with the battery and the Amp-Clamp indicator circuit. The indicating circuit consists of a meter shunted by a fixed resistor. When zero resistance is being measured, or input leads are shorted, maximum current flows in the circuit and the Amp-Clamp indicates a full scale deflection of zero ohms. When the unknown resistance is equal to the fixed shunt resistor, the Amp-Clamp indicates 1/2 full scale deflection. Thus, the value of the resistance being measured controls the amount of current in the indicating circuit.

SECTION VI

MAINTENANCE

6.1 GENERAL

The Amp-Clamp has been carefully designed using high-quality components. With reasonable care, and following the instructions in this manual, a long useful service life can be expected from this Instrument.

6.2 WARRANTY

The Simpson Electric Company warranty policy is printed on the inside back cover of the manual. Read it carefully prior to requesting a warranty repair.

NOTE: For assistance of any kind, including help with the Instrument under warranty, contact your nearest Simpson Authorized Service Center for instructions. These centers are listed on the last pages of this manual. If you wish to contact the factory directly, give full details of the difficulty and include the Instrument model number and date of purchase. Service data or shipping instructions. will be promptly sent to you. If an estimate of charges for non-warranty or other service work is required, a maximum charge estimate will be quoted. This charge will not be exceeded without prior approval.

6.3 CARE

6.3.1 Immediately remove any materials spilled on the Amp-Clamp. Use only a mild detergent in water or alcohol (wood grain, isopropyl or denatured) solvent. Other solvents may damage the plastic and/or reduce the effectiveness of the insulation. Dry the Instrument thoroughly before using it.

6.3.2 Magnetic joint surfaces at the jaw locking area should be maintained clean from residues of wire insulation or any other particles and free from dust and dirt. Also, by keeping the jaws completely closed, the reluctance of the magnetic core is held to a minimum thereby assuring full accurate current readings.

6.4 BATTERY INSTALLATION (Model 296 only)

Proceed as follows (see Figure 6-1):

a. Remove battery and fuse compartment cover located at the bottom of the case, by pressing cover in at the serrated end and sliding it toward the terminal side of the case. This exposes the contact spring and the protective and spare fuses.

b. Remove the contact spring from the compartment.

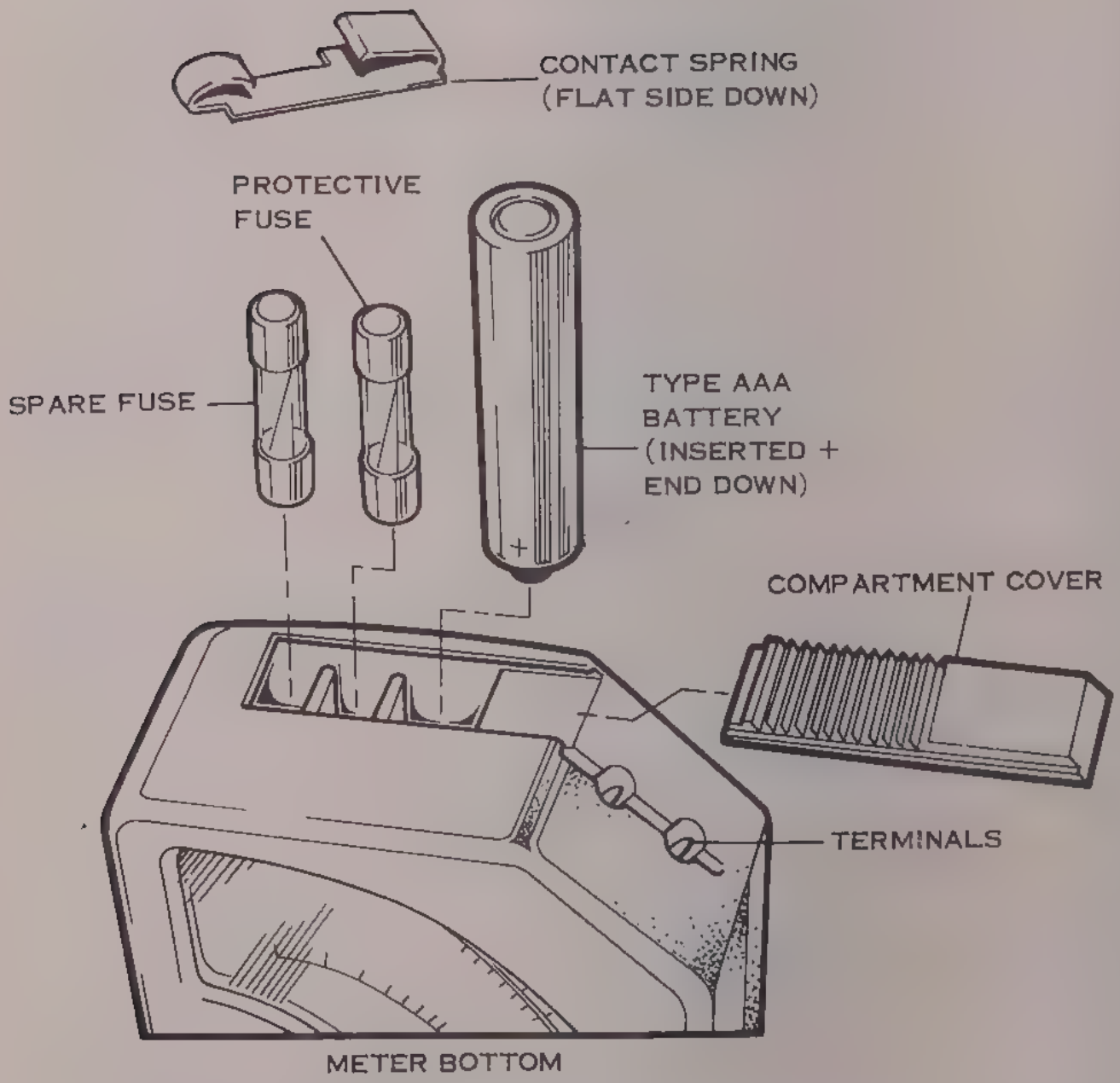

Figure 6-1. Battery Installation and Fuse Location (Model 296 Only)

c. Install the battery, making sure that the positive (+) end is inserted into the bottom of the compartment.

d. Re-insert the contact spring (flat side down), with the wide end over the battery.

e. To replace the compartment cover, slide the serrated end in first.

6.5 BATTERY REMOVAL

Remove the battery from the Amp-Clamp when it is to be stored for long periods of time or when the battery is run-down. The condition of the battery is checked by setting Range Selector to OHMS, connecting the Instrument leads to terminal and shorting leads together. Inability to adjust pointer to zero indicates a weak battery. Refer to Figure 6-1 for battery location.

6.6 FUSE

The fuse is "in" the circuit during resistance measuring, and "out" of the circuit during current or voltage measurements. The active fuse is next to the battery compartment, while the spare fuse is in the outer compartment. Replace the fuse (following instructions in paragraph 6.4), with a 1/4 amp, type 8AG fuse.

SECTION VII

ORDERING INFORMATION, SCHEMATIC DIAGRAM AND AUTHORIZED SERVICE CENTERS

Table 7-1. Items Included With Instruments

Model 294	
Operator's Manual	5-116868
Model 295	
Test Lead, Red	10-830442
Test Lead, Black	10-830441
Operator's Manual	5-116868
Model 296	
Test Lead, Red	10-830442
Test Lead, Black	10-830441
Battery, 1.5V AAA Alkaline	NEDA #24A
(2) Fuse, 1/4 Ampere Type 8AG	5-113997
Operator's Manual	5-116868

Table 7-2. Accessories Available

Description	Part No.
Carrying Case, Black Vinyl	02226
Line Splitter, Model 151	00534

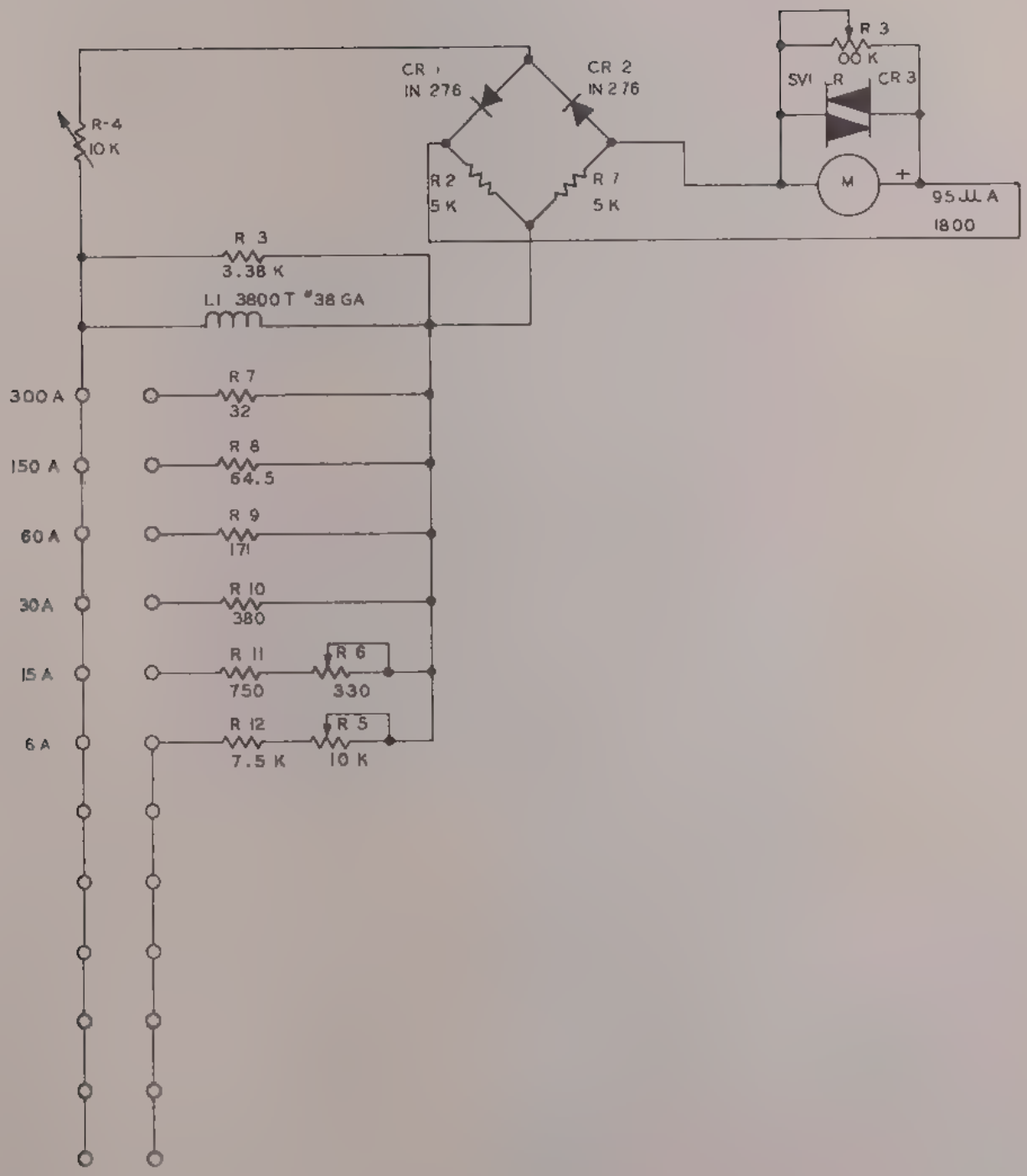

Figure 7-1. Model 294, Schematic Diagram

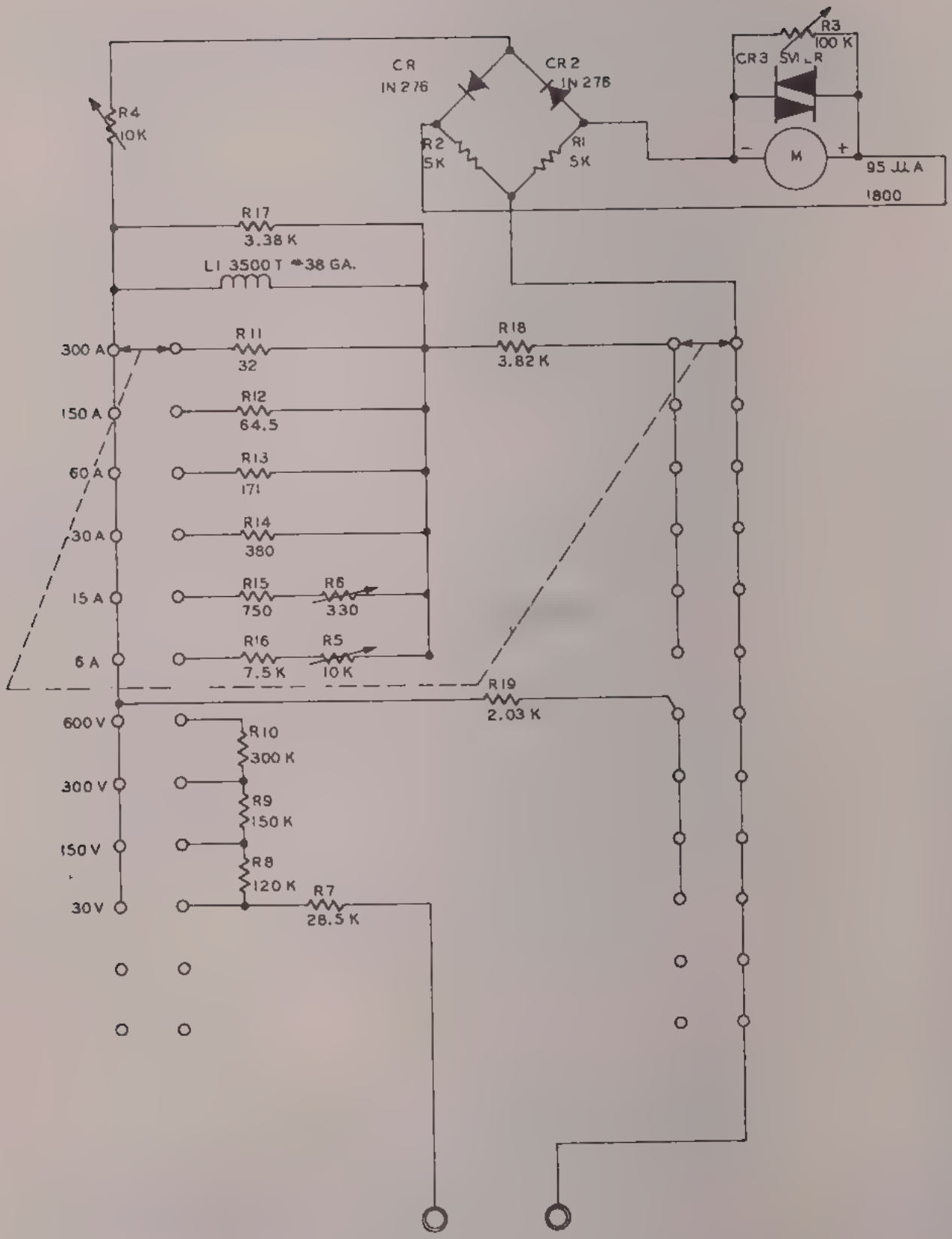

Figure 7-2. Model 295, Schematic Diagram

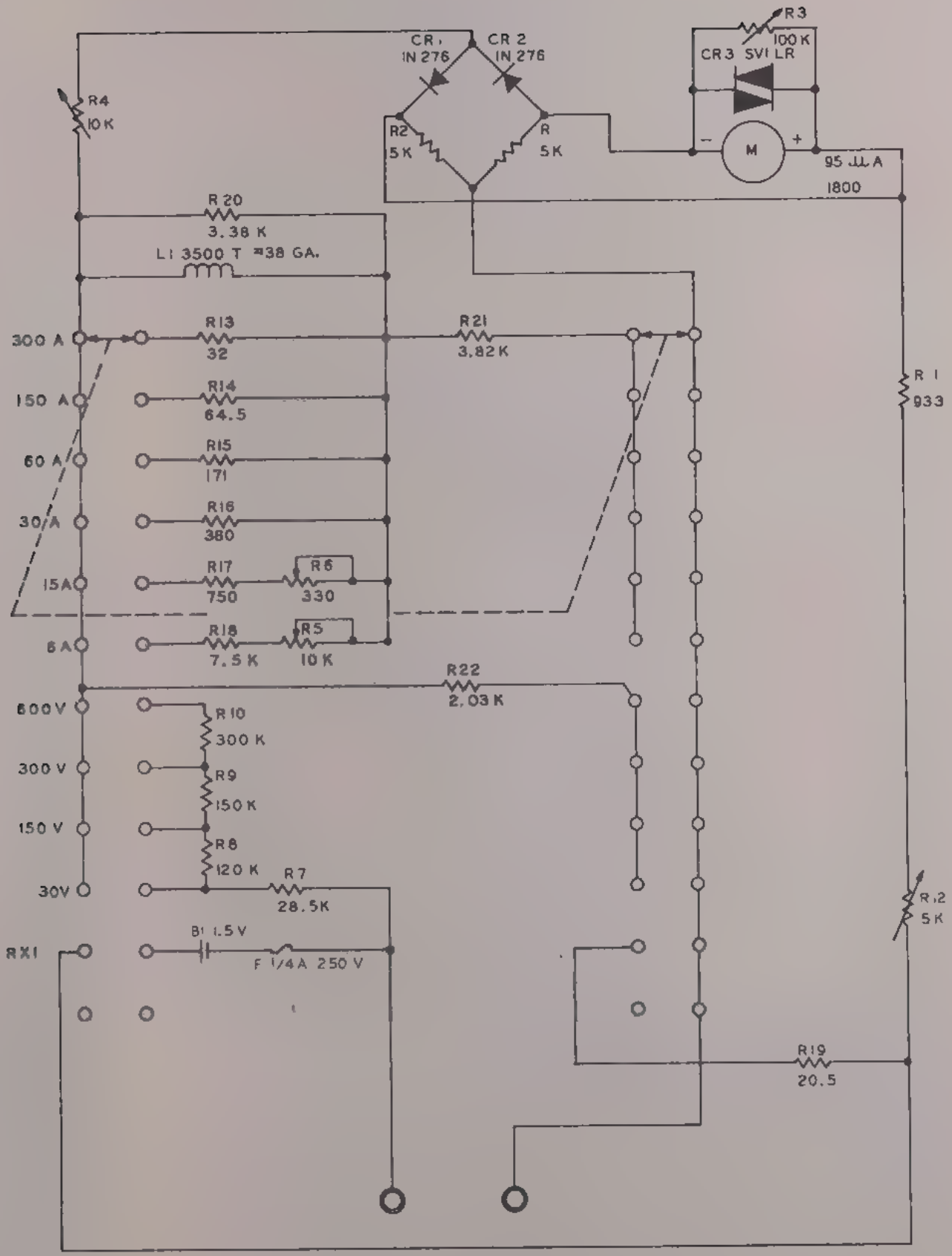

Figure 7-3. Model 296, Schematic Diagram

Table 7-3. Replacement Parts List, Model 294

Reference Symbol	Description	Part No.
CR1, CR2	Diode, 1N276	1-115970
CR3	Diode	1-110670
L1	Coil	5-112050
R1, R2	Resistor, 5 kΩ ±1%	5-116677
R3	Potentiometer, 100 kΩ	5-116664
R4, R5	Potentiometer, 10kΩ	5-116663
R6	Potentiometer, 330 kΩ	5-116662
R7	Resistor, 32Ω ±1%	5-116809
R8	Resistor, 64.5Ω ±1%	5-116669
R9	Resistor, 171Ω ±1%	5-116670
R10	Resistor, 380Ω ±1%	5-116671
R11	Resistor, 750Ω ±1%	5-116672
R12	Resistor, 7.5kΩ ±1%	5-116678
R13	Resistor, 3.38kΩ ±1%	5-116675
	Housing Assembly, Top	10-862911
	Housing Assembly, Bottom	10-862905
	Actuator, Pointer Lock	5-116696
	Knob, Range Selector	3-260591
	Label, Range Selector	5-116814
	Ring, Retaining	5-112657
	Operator's Manual	5-116868

Table 7-4. Replacement Parts List, Model 295

Reference Symbol	Description	Part No.
CR1, CR2	Diode 1N276	1-115970
CR3	Diode	1-110670
L1	Coil	5-112050
R1, R2	Resistor, 5kΩ ±1%	5-116677
R3	Potentiometer, 100kΩ ±20%	5-116664
R4, R5	Potentiometer, 10kΩ ±20%	5-116663
R6	Potentiometer, 330kΩ ±20%	5-116662
R7	Resistor, 28.5kΩ ±1%	5-116679
R8	Resistor, 120kΩ ±1%	5-116680
R9	Resistor, 150kΩ ±1%	5-116681
R10	Resistor, 300kΩ ±1%	5-116808
R11	Resistor, 32Ω ±1%	5-116809
R12	Resistor, 64.5Ω ±1%	5-116669
R13	Resistor, 171Ω ±1%	5-116670
R14	Resistor, 380Ω ±1%	5-116671
R15	Resistor, 750Ω ±1%	5-116672
R16	Resistor, 7.5kΩ ±1%	5-116678
R17	Resistor, 3.38kΩ ±1%	5-116675
R18	Resistor, 3.82kΩ ±1%	5-116676
R19	Resistor, 2.03kΩ ±1%	5-116674
	Test Lead, Red	10-830442
	Test Lead, Black	10-830441
	Alligator Clip (without insulator)	1-115963

Insulator Alligator Clip, Red	5-112479
Housing Assembly, Top	10-862912
Housing Assembly, Bottom	10-862905
Actuator, Pointer Lock	5-116696
Knob, Range Selector	3-260640
Label, Range Selector	5-116815
Operator's Manual	5-116868

Table 7-5. Replacement Parts List, Model 296

Reference Symbol	Description	Part No.
CR1, CR2	Diode, 1N276	1-115970
CR3	Diode	1-110670
F1	Fuse, 1/4A, 8AG	5-113997
L1	Coil	5-112050
R1, R2	Resistor, 5kΩ ±1%	5-116677
R3	Potentiometer, 100kΩ ±20%	5-116664
R4, R5	Potentiometer, 10kΩ ±20%	5-116663
R6	Potentiometer, 330kΩ ±20%	5-116662
R7	Resistor, 28.5kΩ ±1%	5-116679
R8	Resistor, 120kΩ ±1%	5-116680
R9	Resistor, 150kΩ ±1%	5-116681
R10	Resistor, 300kΩ ±1%	5-116808

R11	Resistor, 933kΩ ±1%	5-116673
R12	Potentiometer, 5kΩ ±20%	5-116634
R13	Resistor, 32Ω ±1%	5-116809
R14	Resistor, 645Ω ±1%	5-116669
R15	Resistor, 171Ω ±1%	5-116670
R16	Resistor, 380Ω ±1%	5-116671
R17	Resistor, 750Ω ±1%	5-116672
R18	Resistor, 7.5kΩ ±1%	5-116678
R19	Resistor, 20.5Ω ±1%	5-116667
R20	Resistor, 3.38kΩ ±1%	5-116675
R21	Resistor, 3.82kΩ ±1%	5-116676
R22	Resistor, 2.03kΩ ±1%	5-116674
	Battery Alkaline AAA	NEDA #24A
	Test Lead, Red	10-830442
	Test Lead, Black	10-830441
	Alligator Clip (without Insulator)	1-115963
	Insulator Alligator Clip, Red	5-112479
	Housing Assembly, Top	10-862913
	Housing Assembly, Bottom	10-862905
	Cover, Battery & Fuse Compartment	5-116701
	Spring, Contact	5-116685
	Actuator, Pointer Lock	5-116696
	Knob, Range Selector	3-260640
	Label, Range Selector	5-116816
	Operator's Manual	5-116868

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